ENERINFO

DVISOR

Building an Energy Efficient Home

An Energy Efficient Home

- *costs the same or less to own as a conventional house when monthly payments for taxes, principal, interest, and energy are added together*
- *offers greater comfort and superior air quality, as well as lower energy bills*
- *looks the same as standard housing because many small but important differences are hidden from view*
- *is the basic building block for a sustainable, environmentally responsible home*

NOVA SCOTIA
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Introduction

Canada is a world leader in energy efficient housing. Canada's R-2000 program, for example, has been licensed to Japan and copied in many parts of the United States. Canadians know how to build affordable, comfortable, low energy homes, but we still don't build as many as we should.

Planning a new home involves hundreds of decisions. This fact sheet answers common questions about energy efficient housing and describes products and technologies that offer proven value and performance. More detailed information on specific topics can be found in other publications listed on the back page.

What are the advantages of an energy efficient home?

The major advantage is low energy costs. A home that is inexpensive to heat today will be an even better investment as energy prices increase over time. Modern energy efficient homes also offer superior comfort, air quality and higher resale value.

Where do I start?

Energy efficiency starts at the planning stage. Walls, windows, and other basic building components last a long time. The decisions you make now will determine your home's performance for decades.

Smart home buyers put their money into the building's structure and into durable components. If corners must be cut, remember that decorative elements (which have no payback) can be added later. Windows may not be replaced for 20 years, but lighting, bathroom fixtures, or flooring can be easily upgraded later.

Can I afford an energy efficient home?

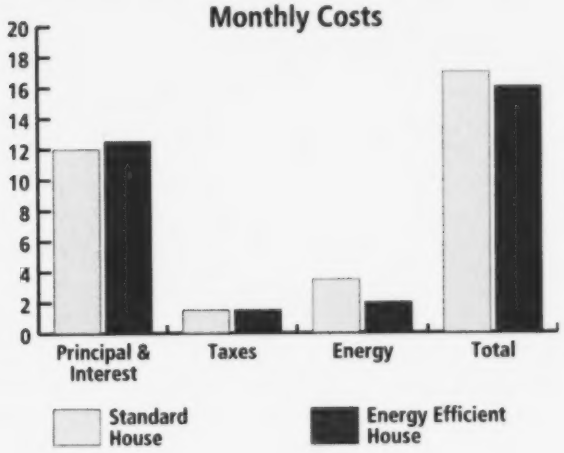
Energy Efficiency
- Comfort, Fewer Drafts
- Superior Air Quality
- Dability & Performance
- Low Energy Bills

Quality materials and the extra attention to detail may make an energy efficient home more expensive to build. But when all your annual costs

(principal, interest, taxes, and energy) are added together, an energy efficient home can actually cost you less to own.

As time passes and energy costs increase, monthly savings from owning an energy efficient home become even larger.

The Low Cost of Energy Efficiency



How much more does an energy efficient home cost?

The estimated cost of upgrading your new home to meet R-2000 standards is 3 to 5 per cent. Builders who are unfamiliar with energy efficient housing techniques may suggest the added cost is much greater. Extra costs usually include fewer air leaks, more insulation, high performance windows, and more efficient and effective ventilation—all desirable features in a home.

Any home design or style can be energy efficient. It is the building's performance, not its appearance, that is different.

What is an R-2000 home?

R-2000 homes are the only certified energy efficient houses on the market. To be certified R-2000, a house must:

1) be built by a contractor who has completed an R-2000 training program

2) meet specified energy targets. Compliance is based on a computer energy analysis of house plans

3) have a controlled ventilation system installed by certified tradespeople to CSA F326-Residential Mechanical Ventilation Standard

4) achieve a specified level of air tightness based on the results of a blower door test

5) pass R-2000 inspections made by an independent inspector

More than Energy Savings

Nova Scotia Home Builders Association
15A Oland Crescent
Bayers Lake Business Park
Halifax, N.S. B3S 1C6

For more information call:
450-5554 or 1-800-668-2001

The R-2000 program can accommodate all housing styles. A wide variety of construction products and methods are permissible. It is overall performance that counts.

Some builders offer clients "almost R-2000" homes at a lower cost if the home is not registered with the program. Without the independent quality control inspections and testing offered through the R-2000 program, the performance of these "almost R-2000 homes" frequently does not measure up in key areas such as heating costs and air quality.

The cost of registering an R-2000 home is about $800, including the inspections and a blower door test. Any greater cost saving claimed for an "almost R-2000 home" indicates that something is being left out or done poorly.

EnerGuide for New Houses

EnerGuide for New Houses uses proven R-2000 computer software to predict the future energy use of specific house plans. For a $350 fee, the EnerGuide service allows home buyers to realistically compare both the costs and benefits of energy efficiency upgrades. Doing this at the planning stage allows energy upgrades to be added at the lowest possible cost.

EnerGuide for New Houses provides professional advice on energy options as well as a final inspection with an air tightness test to independently verify that all specified energy features of the home are included in the finished product.

When the home is complete and receives an EnerGuide inspection, The Nova Scotia Department of Energy will

rebate the homeowner the entire $350 audit cost if the home's EnerGuide rating is 77 or higher. If the EnerGuide rating is less than 77, homeowners will receive a $175 rebate.

Can the sun help me heat my home?

Passive solar energy can supply as much as 30 per cent of the heating needs of an energy efficient home without increasing construction costs. Your home's windows can be an effective and inexpensive way to passively collect free heat from the sun.

The key is to locate windows and living areas on the building's south side. This will maximize solar gain and available light. Spaces where windows are less important, such as garages, utility spaces, halls, and stairwells, should be kept to the north side. Design or choose a home to fit your lot rather than try to impose a design in a location that does not suit it.

To prevent overheating, avoid overhead glass and limit south-facing glass area to a maximum of 8 to 10 per cent of the floor area of connected spaces. Solar heating contributions as high as 60 per cent are possible but require careful balancing of window area, heat storage, and heat distribution systems to avoid uncomfortable temperature swings.

Roof-mounted solar panels are normally used to provide domestic hot water, not space heating. Most solar thermal panel systems are sized to supply about 60 per cent of annual hot water needs.

Can a house be too air tight?

Absolutely not! Air-tight construction is the key to energy efficiency. Sealing all the small cracks and holes helps insulation work better, improves comfort, and prevents condensation damage to the building's structure.

Tight construction allows us to control indoor living conditions regardless of the weather outside. Mechanical ventilation supplies the right amount of fresh air for health and humidity control without creating high energy costs. Surveys indicate air quality in registered R-2000 homes is better than in standard construction.

Airtightness levels can be measured using blower door test equipment. This test determines how tight the building really is. It also provides a useful tool for finding hidden air leaks.

In all new homes, and especially in tighter, more efficient ones, care must be taken with any heating device that uses oil, wood, or gas to ensure that all combustion gases are safely exhausted to the outside. Combustion air may have to be provided for certain appliances.

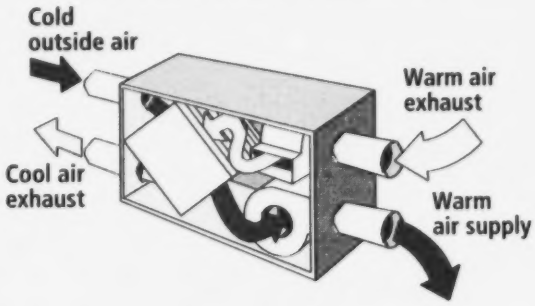
Is a ventilation system necessary?

Effective mechanical ventilation is essential for humidity and pollutant control in new houses. It is also required under the National Building Code.

The best ventilation systems can continuously supply fresh air to all living areas of the home and exhaust stale air from kitchens, bathrooms, and other areas where pollutants are produced. Normally, these systems run continuously at low speed. A high-speed option provides added ventilation for short periods of time when humidity or pollutant levels rise.

Heat recovery ventilators (HRVs) recover heat from exhaust air to reheat fresh air brought into the home from the outdoors. Better models can recover 70 to 80 per cent of the energy in exhaust air. If an HRV is to work well, it must be properly installed and balanced. Poorly designed and installed ducting will cripple the performance of even the best HRV units.

Heat Recovery Ventilator



Are high performance windows better?

Today's better windows are two to three times more efficient than standard thermopanes. Don't build a house without them!

Energy efficient windows can deliver comparatively large savings, because windows are usually the poorest insulated exterior surfaces of a well-insulated building.

Ask for these new window products:

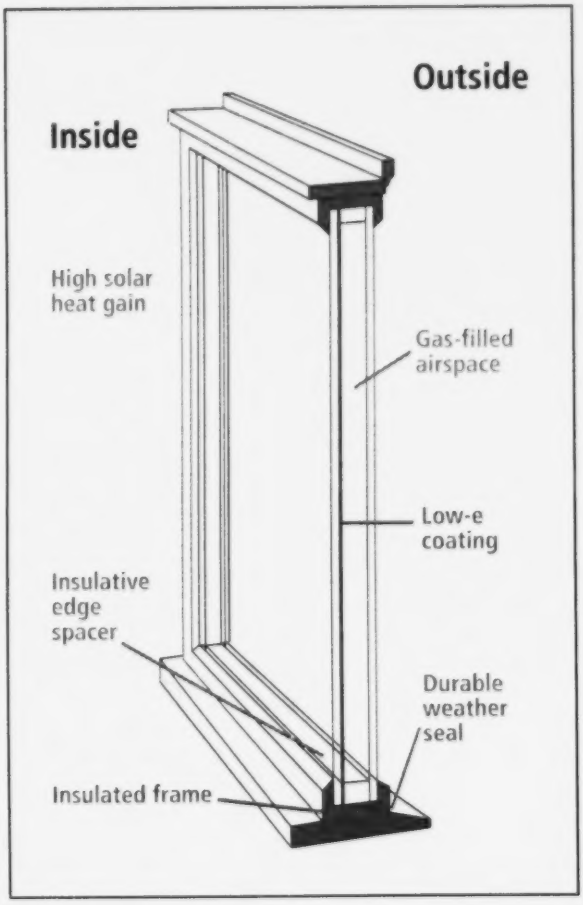
- Selective coatings or films increase R-values. "Low-e" coatings are available from most manufacturers.

- Heavy gases (usually argon) reduce window heat loss. These gases replace the air normally sealed between the glass panes.
- Insulating spacers cut heat loss at the edges of the glass. Older sealed units used highly conductive metal edge spacers, which lowered the temperature at the window's edge and increased the condensation potential.

These energy upgrades may add 10 to 15 per cent to the cost of a standard window. This small extra charge doubles the energy performance of windows and reduces/eliminates condensation.

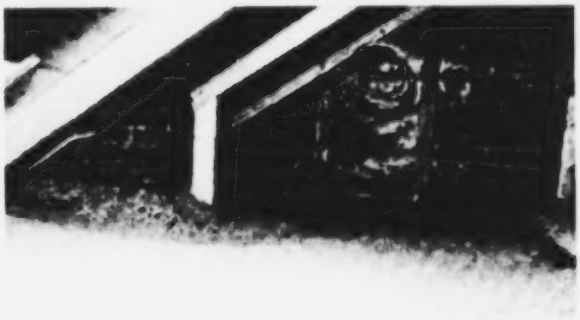
Window buyers should also select a window style that minimizes air leakage. Casement or awning windows are usually tighter than sliding window styles. Where possible, use a fixed window to reduce cost and increase energy savings.

Energy-efficient Window Features



Details of Er

Rigid insulation warms up walls by insulating over studs, headers, and other framing, replaces wood sheathing, and makes R-25 to R-30 walls practical.



Blown attic insulation provides a high level of uniform insulation and plugs up gaps around framing, plumbing stacks, etc.

Window openings are a major source of air leakage. Spray foam insulation and caulking of joints in framing provide a durable and effective seal.

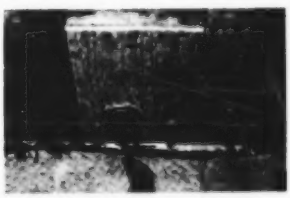
ıergy Efficient Construction

Major Sources of Air Leakage

- foundation wall and rim joist
- floor and top or bottom plate joints
- rough openings around windows and doors
- around electrical boxes for outlets and switches
- around the attic hatch and frame
- where the plumbing vent pipe enters the attic
- at the top of exterior walls
- around ventilation intakes and exhausts, dryer vents, central vacuum exhausts, etc.
- where an interior chimney enters the attic
- at intersecting walls
- ventilation grilles in upper floor ceilings
- around tub or shower enclosures
- where plumbing pipes or drains enter outside walls
- around heaters on outside walls
- around bay windows and cantilevered floors

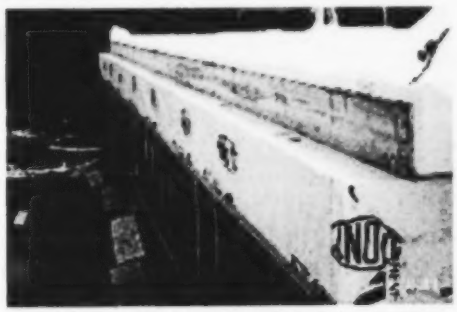
Accoustical sealant between the bottom plate and the concrete provides a good seal against air leakage.

Rigid insulation installed before the garage roof trusses makes insulating less complicated.

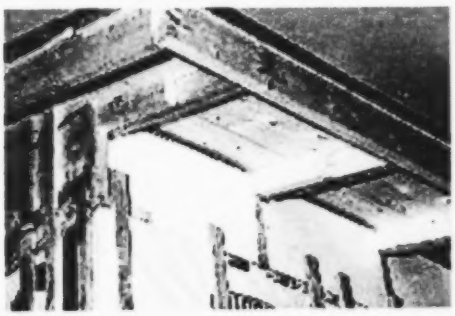


Solid blocking such as plywood holds ventilation ducts in place, providing a solid surface so they can be sealed properly.

Basement walls can be insulated to R-20 by leaving several centimetres between the stud wall and the concrete and placing batts behind the studs as well as between them. Rigid insulation separates the floor slab and the wall.



Wrapping headers with a breathable air barrier is a simple way to seal around the floor platform. The paper is joined to the interior polyethelene above and below the floor.



Blocks of rigid insulation prevent wind from blowing through insulation near the eaves and prevent insulation from blocking the soffit vents.

What is important in the attic?

Blown-in attic insulation offers the best coverage and avoids cutting and fitting batts around truss members. The four keys to energy efficient attics are:

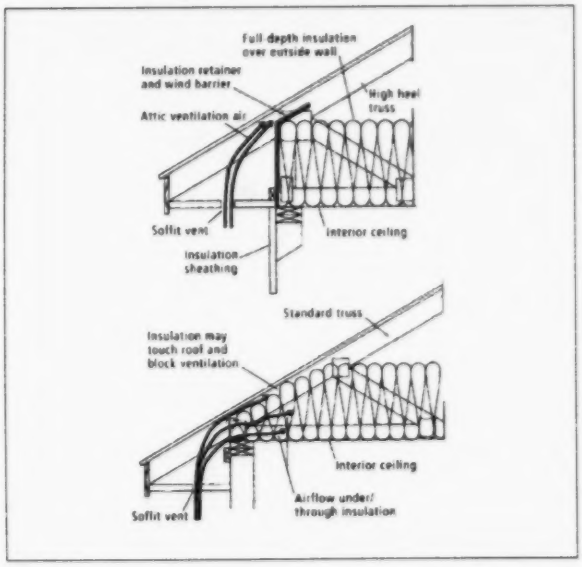
1) Air sealing: Warm moist indoor air leaking into the cold attic space can cause a great deal of damage. It is especially important to air seal at the ceiling level of the top floor since most leakage of indoor air to the outside occurs at the top of the building.

2) Even insulation levels: With standard roof trusses, the ceiling near outside walls is poorly insulated due to lack of space. "High heel" trusses provide the extra room needed to evenly insulate the entire ceiling. In a cathedral roof, use a parallel chord truss to create the space needed for high levels of insulation and prevent heat losses caused by solid rafters.

3) Avoid "wind washing" at the eaves: Cold ventilation air entering soffit vents must be directed past and over insulation. Install baffles made of solid material between roof trusses or rafters. In many cases sheathing can be extended above the top plate to serve as a wind baffle.

4) Ventilation: Effective attic ventilation keeps the underside of the roof cooler, prevents ice dams and keeps the roof cooler during hot weather. Attic ventilation does not control interior humidity levels. It is not a substitute for a tight air seal at the attic ceiling.

Advantages of High Heel Truss



What type of insulation should I use?

Cellulose and glass fibre insulation are the least expensive insulation materials and are the best choices where space is available, such as in the attic.

Rigid board insulations are more expensive but have a higher R-value per inch. Generally, price increases with R-value. Rigid insulations are best suited for use where space is limited, where they can perform two functions (insulating sheathing for example), or where other types of insulation are not suitable (underground). Foam insulation exposed to the interior must be covered by a fire-resistant material such as drywall.

R-Values for Insulation Materials

Insulation Type	R/inch	RSI/inch
glass fibre	2.9 blown, 3.2 batt	0.51 blown, 0.56 batt
cellulose	3.6 blown	0.63 blown
expanded polystyrene	3.7 low density 4.0 high density	.65 low density .7 high density
extruded polystyrene	4.7 low density 5.0 high density	.83 low density .88 high density
semi-rigid glass fibre board	4.2 below grade 4.4 above grade	.74 below grade .77 above grade
polyurethane foam	6.0	1.06
resol phenolic foam	7.5	1.32

Is one type of wall better than another?

There are many systems for building energy efficient walls. Your choice will likely depend on the builder's preference, cost of construction, and how complicated your house design is. Common approaches are:

1) Stud walls (usually 2" x 6") with non-insulating sheathing such as boards, plywood, particle boards, OSB, etc. Performance suffers because there is no insulation over studs or other wood framing. Batts may be poorly installed with gaps around framing members. The R-value of 2" x 6" walls is about R-17.3 when the studs and other framing are taken into account.

2) Stud walls with insulating sheathing offer superior performance. Rigid exterior insulation replaces conventional wood sheathing products and provides a continuous layer of insulation over all framing members. In fact, a 2" x 4" stud wall covered with 1 1/2" (3.75 cm) of rigid insulation will outperform a 2" x 6" wall with plywood or tongue and groove board. Insulation levels above R-20 are practical using 2" x 6" studs and rigid insulation instead of wood sheathing.

3) Insulated concrete forming systems: Concrete is poured between layers of rigid insulation. These walls have a very good R-value and tend to be very airtight.

4) Wrap and strap: This system straps the stud wall horizontally on the interior to allow for extra insulation and to minimize heat loss through framing members. The polyethylene air/vapour barrier is installed and sealed before the wall is strapped, so wiring can be run inside the air vapour barrier without any additional air sealing measures.

5) Proprietary Systems: The most commonly available patented system in Nova Scotia is "Insulwall." Wood studs are placed in precut expanded polystyrene insulation. Most framing does not extend through the entire wall but is protected by insulation to improve energy performance.

6) Truss walls: This system uses a truss to replace wall studs. By increasing the space between the inner and outer truss members, large amounts of insulation can be accommodated. This type of system is usually best suited to fairly simple buildings.

7) Double wall construction: This system uses both an inner and outer stud wall. Extra insulation can be added by increasing the space between the walls. This system is not commonly used due to the high labour and material costs associated with building two walls.

How much insulation is enough?

Today's higher recommended insulation levels reflect the impact rising energy costs have had on the financial viability of investing in a more efficient building. Past experience shows that these insulation levels should be viewed as minimums. Houses last a long time. The energy you avoid buying by building a more efficient home will never increase in price.

Insulation Levels

Walls	R-25
Ceiling	R-50
Basement Walls	R-20
Windows—Low e glass, argon, insulated spacers	
Basement Floors	R-5 under the slab
Heated Basement Floors	R-10 under the slab

R-20 basement insulation can be obtained at low cost by moving the 2" x 4" studs 2" (5 cm) from the basement wall and insulating behind them with batt insulation. Insulate under the basement floor with 2" (5 cm) of rigid insulation to a distance of 4' (1.2 m) inwards from the exterior walls. Insulate the entire floor slab to R-10 if a radiant heating system is being installed.

What is the best heating system?

The best investment in home heating is an energy efficient home that requires little heat and takes advantage of free heat from the sun. In these homes nearly any type of heating system is affordable to operate.

The table below compares the cost of providing heat energy with common fuel types. Fuel Prices are current as of October 2005 and do not include taxes. Propane prices vary according to the amount consumed. Prices may also vary according to supplier and location in the province.

Fuel Cost Comparison

Source	Price/Unit*	$/Mil BTU
Oil Furnace or boiler	79.9¢/litre	$30.34
Electric baseboard	9.22¢/kwh	$31.07
Air-to-air heat pump	9.22¢/kwh	$16.35
Ground source heat pump	9.22¢/kwh	$10.36
Direct vent propane fireplace	80¢/litre	$69.63
High efficiency propane furnace	80¢/litre	$40.02
EPA-rated woodstove	$200/cord	$13.15
Pellet stove	$213/tonne	$20.58
Natural gas (high efficiency)	$14.310/GJ	$18.67
Natural gas (standard efficiency)	$14.31/GJ	$24.80

* does not include HST

Choose the heating system that best meets your needs based on your comfort expectations, budget, and the characteristics of your home.

Owners of smaller homes built to R-2000 standards or better may find it difficult to justify an expensive heating system that promises to save on operating costs. Saving half of $500 a year in heating costs does not quickly repay extra purchase costs. Savings may also be offset by extra maintenance costs.

In larger or less efficient homes, fuel costs become important. Heating systems with high operating costs can turn out to be a poor choice no matter how little they cost initially.

More detailed information on heating system options and fuel cost comparisons can be found in the publication *Introduction to Home Heating* available from ENERINFO.

Do basements have to be damp?

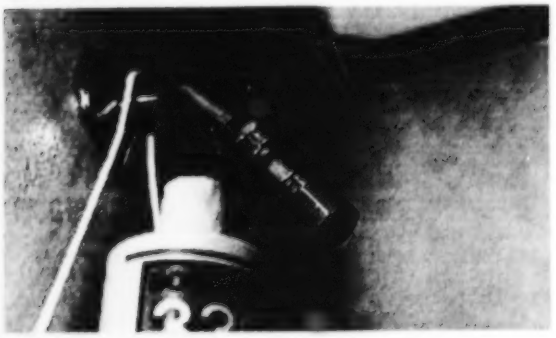
During the summer months, the earth around basement floors and walls can cool concrete surfaces enough to encourage condensation and mould growth. Ventilating the basement during the summer with humid outdoor air brings in more moisture and may increase condensation rates rather than cure the problem.

Basement wall and floor insulation can prevent condensation by separating the cool earth from the concrete floor and walls (exterior insulation) or preventing humid air from reaching the cool concrete (interior insulation and good air/vapour barrier). Fully insulated and air sealed basements are not damp. Of course, basement insulation also reduces winter heating bills.

Can I cut other energy costs?

In an energy efficient home, both hot water and general household electrical bills can be higher than space heating costs. Energy efficiency is important when choosing products, appliances, and fixtures for your home.

Hot Water



- Low flow shower heads reduce water use.
- Water heater tank insulation blankets reduce energy use.
- Choose an efficient water heater.
- Pipe insulation works. Cover at least the first 10' (3 m) of hot and cold water piping.
- Install the hot water tank on a block of rigid foam insulation.

Lighting

- Select fluorescent fixtures for lights that are frequently used.
- Invest in high efficiency outdoor lighting.
- Use task lighting.

Appliances

Look for the ENERGY STAR® symbol to choose the most energy efficient appliances.

ENERGY STAR
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The ENERinfo Advisor Series

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- *Passive Solar Homes*
- *Ventilation for New Homes*
- *Ventilation for Older Homes*
- *Selecting Energy Efficient Windows*
- *Introduction to Home Heating*

Other Information Sources

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